1,105,031

PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

A Salt Bath for Nitriding Steel and Cast Iron

We, DEUTSCHE GOLD-UND SILBER-SCHEIDEANSTALT VORMALS ROESSLER, a body corporate organised under the laws of Germany, of 9 Weissfrauenstrasse, Frankfurt/Main, Germany. do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a salt bath for nitriding steel and cast iron.

It is known that baths consisting essentially of potassium and sodium cyanides or cyanates, may be used for nitriding different kinds of steel in a salt bath. The oldest known nitriding baths were prepared, for example, from a mixture of about 50% by weight of KCN and about 50% by weight of NaCN, solely by reason of the melting point which should lie between 500° and 600°C.

Also known are nitriding salts consisting of 40% by weight of KCNO and 60% by weight of NaCN, or salts which were mainly used to replenish ventilated nitriding baths and which consisted of 70% by weight of NaCN and 30% by weight of KCN. Nitriding baths consisting solely of potassium compounds are rarely used on an industrial scale because they have a weak nitriding effect. In contrast, nitriding baths consisting solely of sodium compounds are commonly used. Unfortunately, these nitriding baths produce very porous connecting zones.

The success of nitriding in a salt bath depends on the formation of a largely pore-free and thick connecting zone, because this is of considerable importance as far as the desired wear-resistant properties are concerned.

If, for example, a carbon-steel sample is nitrided in a salt bath consisting of 55% by weight of NaCN, 35% by weight of NaCNO and 10% by weight of sodium carbonate, a connecting layer is formed over a period of 90 minutes at 570° C. which, although about 15 μ thick, is porous throughout and, in some cases, readily displaceable, as shown in practice.

Similar nitriding treatment in a bath consisting of 35% by weight of KCNO, 50% by weight of NaCN and 15% by weight of sodium carbonate, produces a connecting layer with a thickness of between 10 and 12 μ. Once again, the connecting layer is porous and, in some cases, displaceable.

It is known that these drawbacks may be avoided by using iron-free crucibles, for example, those lined with titanium. It has been found, however, that porous connecting zones may nevertheless be formed under certain conditions, for example, in the treatment of castings with a thick casting skin, or in cases where, for some reason or other, for example, after heavy charges have been lowered without having been pre-heated, the temperature of the bath remains considerably below 570° C. for prolonged periods.

It has unexpectedly been found that the potassium and sodium content of the nitriding bath has a marked bearing on the development of the connecting zone. The present invention provides a salt bath for nitriding steel and cast iron which salt bath contains potassium and sodium ions and cyanide and cyanate ions, the weight of potassium to sodium (based on the pure metal) being from 1:1 to 1.857:1. With this composition of the bath, it is possible to produce a pore-free and non-displaceable connecting layer, even in the treatment of cast iron or in the event of a prolonged, unavoidable drop in temperature to below 550° C.

The accompanying drawing illustrates the conditions. The thickness of the connecting layer is plotted against the potassium-sodium

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metal ratio of the cyanide- and cyanate-containing salt melt. It can be seen that there is comparatively little change in the thickness of the connecting layer up to a potassium content of 65% by weight and a sodium content of 35% by weight. Up to a potassium content of 50% by weight and a sodium content of 50% by weight, however, the connecting layer may be porous and displaceable under the unfavourable conditions referred to, whilst in cases where the potassium content is in excess of 50% by weight, pore-free and non-displaceable connecting layers are formed, even under operationally unsatisfactory conditions. In each case, the treatment was continued for 90 minutes at 570°C. The nitriding baths are therefore extremely dependable in service in the range between 50% by weight of potassium and 50% by weight of sodium, and between 65% by weight of potassium and 35% by weight of sodium.

A bath of this type is prepared by using a salt mixture consisting of 38 to 44% by weight of sodium cyanide, 43 to 47% by weight of potassium cyanate, 2 to 6% by weight of sodium carbonate and 10 to 14% by weight of potassium carbonate.

Since carbonate is formed when the bath is in use by the decomposition of the cyanide or cyanate, and since cyanate ions are formed *in situ*, by reaction of cyanide ions with oxygen, for example, atmospheric oxygen, the bath is preferably replenished with a salt mixture consisting of 44 to 59% by weight of potassium cyanide and 41 to 56% by weight of sodium cyanide.

It is of advantage to use an iron-free crucible, for example a titanium-lined crucible, for the salt baths according to the invention. Similarly, it is of advantage in most cases to ventilate the salt bath in a manner known *per se*, i.e. to pass air or any other oxygen-containing gas in fine distribution through the salt melt.

WHAT WE CLAIM IS:—

1. A salt bath for nitriding steel and cast iron which salt bath contains potassium and sodium ions and cyanide and cyanate ions the weight ratio of potassium to sodium (based on the pure metal) being from 1:1 to 1.857:1.

2. A salt mixture for preparing the bath as claimed in claim 1, consisting of from 38 to 44% by weight of sodium cyanide, from 43 to 47% by weight of potassium cyanate, from 2 to 6% by weight of sodium carbonate and from 10 to 14% by weight of potassium carbonate.

3. A nitriding process using a salt bath as claimed in claim 1, wherein an iron-free crucible is used.

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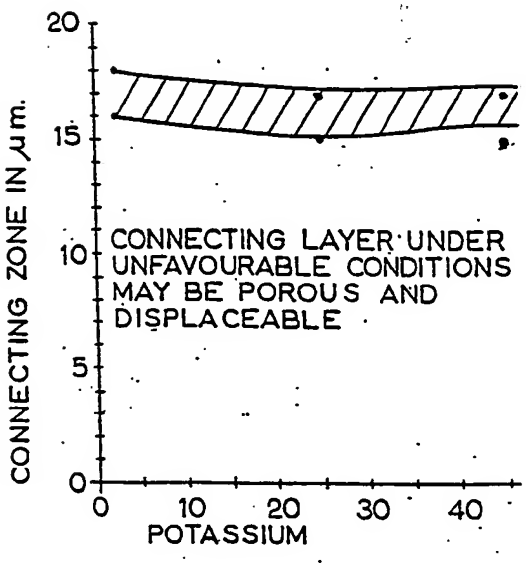

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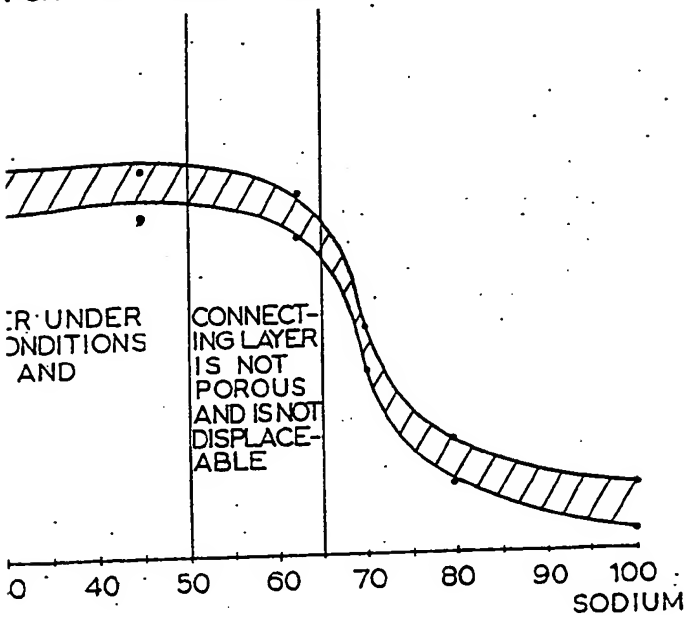

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